Topics in Computational Inference

David M. Allen
University of Kentucky

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8 Differential Equations

This chapter is on numerical solution of differential equations. The seminal book on computer methods for ordinary differential equations is Ascher and Petzold [1]. From that book it is not difficult to program some methods, e.g. Runge-Kutta, directly in C++. And doing so might provide some insights. However, for production work one should use an established library. The *GNU Scientific Library* (GSL) is used here.

Section 8.1 — Downloading

The GSL homepage is
https://www.gnu.org/software/gsl/.

The download page is
http://ftpmirror.gnu.org/gsl/.

Download the file gsl-2.5.tar.gz.

Unpacking and Installing

Change to the directory where the file was placed. Unpack with tar -xvzf gsl-2.5.tar.gz. Change directory to gsl-2.5 and execute the commands

```
./configure
make
sudo make install
```

If for some reason, things do not go well, read the README and INSTALL files.

Documentation

There is html and pdf documentation. The html documentation is at

https://www.gnu.org/software/gsl/doc/html/index.html

For our work, go the "Ordinary differential equation" section.

An Exercise

Exercise 8.1. Use the GNU scientific library ode functions to tabulate values from the compartmental model in Figure 8.1. Use R to plot the values in "Plasma" and "Other". You will need to experiment to find a range of t that gives a pleasing result.
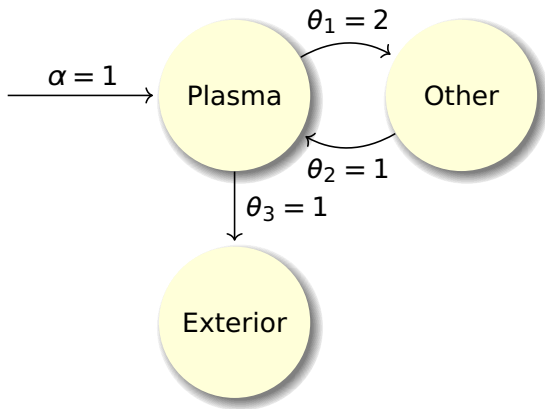
Figure 8.1:

References

[1]   Uri M. Ascher and Linda R. Petzold. *Computer Methods for Ordinary Differential Equations and Differential-Algebraic Equations*. Philadelphia: Society for Industrial and Applied Mathematics, 1998.